

DEVELOPMENT OF AN ENTERPRISE-WIDE ENERGY INFORMATION AND UTILITY MONITORING SYSTEM IN A MAJOR HOTEL CHAIN: HYATT HOTELS CORPORATION EXPERIENCE

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ABSTRACT

Hyatt Hotels Corporation is currently implementing an enterprise-wide Energy Information and Utility Monitoring System (UMS). New Horizon Technologies and eComponents Technology have teamed to provide an integrated solution that will ultimately include all Hyatt Hotels in North America. In addition, these 120 Hyatt Hotels participate in a monthly web-based energy benchmarking and hotel engineering reporting system. For hotels with Utility Monitoring Systems (UMS) installed, energy and water consumption data is automatically summarized for the web reports. Hotels without the UMS enter monthly utility data manually on the website.

The base UMS at the hotels consists of electric, gas and domestic water consumption and local temperature and relative humidity measurements. The Hyatt UMS is one of the first enterprise-wide systems to include domestic water metering. Many hotels elect to install additional sub-metering for major loads or end uses such as chillers, kitchens and laundries.

The local hotel UMS consists of a data acquisition system capable of displaying real-time data that also logs 15-minute interval data. The system transfers interval data daily, to a data center and also transfers interval data hourly, via a Local Area Network, to an on-site workstation with a local database. The local workstation permits users to have real-time alarming capability, access to easy-to-use data visualization and analysis tools, and the ability to generate both customized and standard daily and monthly reports. Report writing and utility costing software are used to generate daily and month-to-date cost reports. Bill estimation software uses actual utility rate tariff models to create estimates of utility costs for any custom defined period.

Data resident in the Hyatt data center is accessible to the individual hotels using a web-based system. Senior engineers with authorization can access data for all Hyatt Hotels in their regions. The corporate energy director and senior management have access to all data in the Hyatt data center.

Browser-based hotel benchmarking data is also available through a similar system with an authorization hierarchy.

This paper will describe the design and implementation of the Hyatt UMS in detail, review how the system is currently being used by Hyatt personnel, discuss potential future applications and provide an initial look at UMS system-wide data, including a preliminary return on investment (ROI) analysis.

BACKGROUND AND INTRODUCTION

Hyatt Hotels Corporation manages approximately 120 hotels throughout North America. The Corporation's annual utility costs are in excess of \$100 million with many hotels having individual annual energy costs in excess of \$1,000,000. Energy and water costs are thus key elements in Hyatt's cost structure and a focus of Hyatt management. To facilitate better access to energy information and promote energy-efficiency, in early 1999 Hyatt released a Request for Proposals seeking a Utility Monitoring System that would provide corporate-wide access to energy information based on 15-minute interval gas, electric and water consumption data. After an extensive search, Hyatt narrowed the selection down to four finalists and ultimately selected New Horizon Technologies and subcontractor eComponents Technology to provide their Utility Monitoring System (UMS).

The initial pilot installation was completed at the Park Hyatt San Francisco in the summer of 2000. Full-scale corporate-wide implementation began in the fall of 2000 and to date approximately 55 hotels in the Hyatt system have installed the UMS.

SYSTEM DESCRIPTION

The Hyatt UMS is an enterprise-level solution, but many of the principal components of the UMS are installed at the local hotel. An overall schematic drawing of the Hyatt utility monitoring system is shown in Figure 1. The central element of the local UMS is a "ThinServer." The ThinServer, in essence, is a single-board computer with an embedded Linux operating system, pulse counting channels and

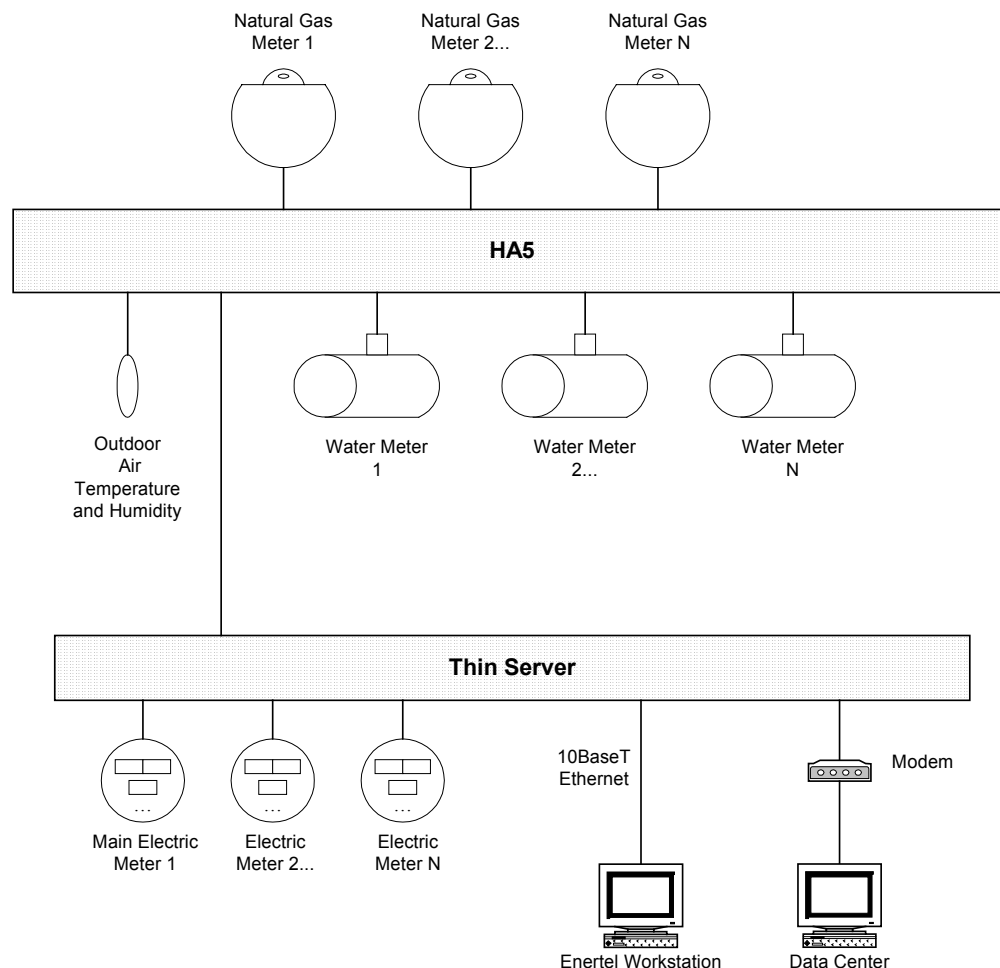


Figure 1. Generic Hyatt Hotel Installation

several communications ports. These communications ports support 10baseT Ethernet as well as RS-232 and RS-485 communications. The system includes telephone-based modem communication and supports TCP/IP.

Each ThinServer can support up to 67 channels of data collection. The current base monitoring system includes service entrance level electricity, natural gas, domestic water and outdoor temperature and relative humidity monitoring at each Hotel site. Sub-metering of major equipment or end-uses such as chillers, laundries and restaurants is also included at some sites. Currently, a maximum of 21 data points is collected at a single site.

The ThinServer transfers data hourly to a local workstation that operates EnerTel® software. EnerTel, developed by eComponents Technology and New Horizon Technologies provides real-time data display, alarming capability, the ability to track and

model energy costs on a daily or month-to-date cumulative basis using actual utility tariffs, data visualization, extensive data analysis and the ability to develop and produce custom reports.

The ThinServer also transfers data daily to the eComponents Technology Enterprise Data Center. The data center is an integrated proprietary database management system on a Microsoft SQL Server® platform. The data center provides daily data validation and verification routines to test the data imported from the ThinServers at each hotel. These routines inspect data for missing, duplicate and out-of-sequence data points, compliance with range limits, on/off load conditions and abnormal load shapes. Verification exceptions for individual hotel sites are summarized daily in an automatically generated report. This information is reviewed each day to provide “proactive” system maintenance follow-up with the local hotel as necessary.

The data center also provides internet-based data access to Hyatt staff throughout the Enterprise via eComponents' WebActive™ Server and browser client. Senior engineers with appropriate permission can access data for all hotels within their span of management authority. They can compare consumption and load shapes among their various hotels and create customized views of data for recurring analysis and reporting. The corporate director of energy and other senior Hyatt management personnel have access to data from all of the hotels with Utility Management Systems installed.

Hyatt Hotels Corporation has also implemented a web-based energy benchmarking and engineering reporting service to replace a manually operated system. The custom reporting service collects utility consumption data and hotel information such as the number of guest nights, occupied rooms, food covers served as well as information for preventive maintenance and smoke detector room checks via web forms. For the UMS hotels, utility consumption and weather related data are automatically extracted from the enterprise data center for the monthly web forms. Hotels without a UMS enter data manually. The web form data is submitted monthly, automatically generating on-line reports for: Energy Benchmarks with BTU's of energy and gallons of water consumed per square foot and per guest night, Consumption Predicted versus Actual based on multiple regression models for each hotel, Comparative Data for all utility types for the current and previous year, and Preventive Maintenance and Smoke Detector Room Check reports for each hotel.

Historic benchmark data is accessible through the data center. A security authorization hierarchy is in place so that appropriate management personnel can access data from multiple sites or the entire hotel system. Monthly energy and water benchmark comparison reports and engineering compliance reports for preventive maintenance and smoke detector checks are distributed across the enterprise to senior engineers and management and is one of the metrics used to evaluate hotel operation.

OPERATIONAL EXPERIENCE

Utility Monitoring Systems have been in place for over two years in many Hyatt Hotels and substantial operating experience has been obtained. The systems have been used in a broad range of applications; some of which are described herein.

Load Shape Analysis

One of the most common applications of the UMS is load shape analysis. Hotel engineering directors use the UMS to identify periods of peak consumption, to understand when and by inference why periods of high and low consumption occur, and to see if unusual or unexplained consumption is occurring. Daily and monthly loads shapes provide a valuable tool for building engineers to manage their buildings and manage their patterns of operation.

Energy Conservation Opportunity Identification

Once local engineers become familiar with their building load shapes, they can begin to identify energy consumption patterns that lead to opportunities to improve energy efficiency. For example, the Director of Engineering at a large Hyatt property identified an unusual natural gas consumption pattern in the middle of the night. The unusual consumption was traced to the kitchen and ultimately to kitchen cleaning practices. Cleaning personnel were turning on kitchen appliances as part of the cleaning process, contrary to standard hotel practices. This same cleaning practice was later discovered in other Hyatt properties.

Operations and Maintenance Problem Identification

Load shape analysis can also be used to identify operations and maintenance problems. One Hyatt engineer with a large ballroom uses the UMS to verify the operation of some components of his energy management and control system, particularly his ballroom lighting control. The load shapes from the UMS pinpoint the time the ballroom lights are turned out and thus when modifications to the lighting control system have been made or the system overridden.

Daily and Monthly Energy Reports

The UMS automatically generates daily and monthly energy reports either to the desktop or as a printed report each morning for the Director of Engineering. The reports include previous day, month-to-date and/or previous month energy consumption and cost information. This automated reporting feature is highly valued by engineering personnel who are frequently very busy and often lack the time to generate, let alone study and act on, manual reports.

Utility Bill Verification

The UMS has been used by a number of hotels for detailed energy bill verification. Most hotels use their UMS to routinely monitor their energy consumption and check their utility bills. As part of

the UMS service, all meters are formally verified against hotel utility bills or manual readings every six months. The vast majority of UMS meter verification tests agree very closely with utility readings. Occasionally, however there are discrepancies. These discrepancies are tracked down and the actual consumption verified. When billing errors are identified, this application can have substantial monetary value to the hotels.

Energy Consumption Threshold Alarming

The UMS can display and operate on real-time data from all meters in the system. This means that in addition to tracking consumption in real-time, threshold consumption alarms can be set. These alarms can be set to notify engineering personnel when certain consumption levels are approached. These alarms are particularly useful with time-of-use rate structures since engineering personnel can be notified in advance to take actions to control loads. Future implementations of the UMS will include the capability to send an alarm-based digital control signal to an energy management system to further automate the alarm functionality.

WATER METERING

The measurement of domestic water with the UMS is probably the most challenging of the metering technologies deployed. Electric and, to a lesser degree, gas utilities are familiar with customer requests for meter access or redundant metering to provide end-users with access to interval meter data. However, many Hyatt Hotels are served by municipal water utilities that are unfamiliar with “pulse retrofits” or shared metering technology. Furthermore, the automated meter reading technology employed by many water utilities is incompatible with certain pulse retrofit devices. The Hyatt UMS is one of the first enterprise-scale monitoring systems to provide the option of obtaining domestic water monitoring data and most hotels are taking advantage of the opportunity. This has resulted in a “learning experience” for both Hyatt Hotels Corporation and New Horizon Technologies.

There are several different approaches to domestic water metering that are being used in the UMS project. Some hotels are retrofitting existing water meters with a pulse output. Other hotels are installing new water meters.

The least cost approach is to install a pulse output device on the hotel’s existing utility water meter. In that way both the hotel and the utility are sharing the same meter signal. However, some water utilities will not permit such a device to be installed.

NHT is now deploying a non-intrusive pulse retrofit device that is compatible with most water meters and automated meter reading systems. But permission to install the retrofit device is still required from the utility that owns the meter and the process to obtain that permission can be cumbersome and time-consuming.

The alternative approach is to install a new, redundant water meter. Due to cost and the requirement for a water outage to install the new meter, insertion water meters are often the preferred alternative. Insertion meters are installed through a “wet tap” and an outage is not required.

However, placement of an insertion meter is critical. Five to ten pipe diameters of straight, unobstructed flow both before and after the meter are required for good accuracy. Also, care must be taken to install the insertion meter to the proper depth.

Water meters are typically most accurate over a relatively narrow flow range. Utilities often overcome this difficulty by installing a compound meter that essentially is a dual meter with one meter registering high flows and the other meter registering low flows. A drawback to insertion meters is that while they are normally scaled to be as accurate as possible over as wide a range as possible, they generally do not record very low flows accurately and “cut out” or record zero flow while water is still flowing. The insertion flow meter used in the Hyatt UMS cuts-out at about 0.17 FPS. New Horizon Technologies (NHT) tracks the accuracy of all of the insertion meters installed in the UMS and calculates and applies a correction factor to meters where the low flow variation is significant.

Another drawback with turbine-type insertion meters is that they can become clogged with debris and lose accuracy or fail entirely. This problem has been encountered at a few Hyatt locations. NHT plans to test an ultrasonic insertion meter that will have no moving parts in the UMS. This new technology should be a major step forward. In situations where higher accuracy is required and a shutdown can be accommodated, NHT recommends the use of in-line turbine or compound-turbine flow meters.

UMS MAINTENANCE AND TECHNICAL SUPPORT

The Hyatt UMS includes a comprehensive software and hardware maintenance and technical support program. The maintenance is a Total Care

Package and covers essentially everything, hardware as well as software. It includes the following:

- Toll-free Technical Support Hot-line staffed 9:00 AM to 5:00 PM Central Time, Monday through Friday excluding Holidays (New Years, Memorial Day, July 4, Labor Day, Thanksgiving Day and following Friday, Christmas Day)
- On-line Manuals, Technical Bulletins
- On-site Computer Hardware Support – Premium next day service
- On-site Meter and Communications Hardware Support
- Extended parts warranty on major UMS Components (Computer, ThinServer & Modem)
- On-line UMS Software Support
- Annual Maintenance Site Visit
- Daily System Communications and Data Verification Checks

Software Upgrades

The maintenance program also provides for software version upgrades that incorporate major functionality improvements as well as routine software fixes. Hotels have now received their third EnerTel Service Pack upgrade. While some of the upgrades, such as the updated graphing and reporting capabilities, are obvious, other changes are invisible yet critical. For example, Service Pack 2 repaired several security issues related to the Windows NT operating system and included database optimization and automated back-up tools. The ThinServer, the principal data acquisition component of the Utility Monitoring System received one, and in many cases two software upgrades last year. One of those upgrades substantially improved the real-time data display.

Software Upgrade Training Services

Additional training for software upgrades or “refresher” training for current installations is provided upon request at no additional charge.

Enterprise-Level Solution

The Utility Monitoring System is a complex network. Not only is there a local network at the hotel that provides hourly data updates, there is also a Hyatt-wide (enterprise-wide) network that collects and updates data from every Hyatt UMS on a daily basis. The maintenance and technical support program includes data transmission to the enterprise data center as well. Essentially this enterprise data center provides redundancy (back-ups) for all the sites. If the local database or back-up tapes become corrupt, the historical data can be restored from the enterprise network.

The Least-Cost Solution

Maintenance is time consuming and expensive. With the level of service that is provided and the complexity of the overall system, the maintenance program is the least cost approach to quality information. Given the everyday priorities of running a hotel, there is no way local personnel could give the UMS the priority it deserves. And with the data quality requirements of an enterprise-level system, comprehensive maintenance support is required.

RESULTS AND COST-EFFECTIVENESS

Hyatt Hotels Corporation plans to measure the cost-effectiveness of the UMS as a stand-alone energy conservation tool. However, the UMS is also being used to replace a manual energy benchmarking system that has been in place for a number of years. This automation is an added benefit of the UMS that has greatly benefited data accessibility. A description of the Hyatt energy-benchmarking program follows.

Benchmarking

Hyatt Hotels Corporation has implemented an extensive energy benchmarking system. All of the individual hotels in the Corporation are benchmarked against one another. They are also benchmarked by geographic region and by hotel type. Ultimately, the benchmarking will be implemented entirely by the UMS. Currently, benchmarking is implemented through a combination of UMS and manually entered data. Summary total energy consumption and cost benchmarking data for the period January – April 2003 are shown in Table 1 as an example of the types of data collected. Hyatt maintains at least 3 years of benchmark data for every hotel in their system.

Table 1. Hyatt Hotel Energy Benchmarking

January - April 2003		
Hotel Type	BTU/S.F.	\$/S.F.
Resort	45,400	\$0.83
Airport	35,300	\$0.48
Convention	41,000	\$0.54
Downtown	40,600	\$0.56
Suburban	43,300	\$0.54
Average	42,500	\$0.59

For the January-April 2003 time period, the average Hyatt Hotel total energy consumption was 42,500 BTU per square foot. This results in an average energy cost of \$0.59 per square foot for the four-month period. The consumption ranged from 11,217 BTUs per square foot to 84,486 BTUs per square foot and costs ranged from \$0.15 to \$1.94 per

square foot. The anomalously high, energy costs per square foot of the resort hotels reflects their locations in prime vacation spots such as Hawaii and the Caribbean.

Return-on-Investment

Some very preliminary cost-effectiveness analysis of the Hyatt UMS has been conducted. Following are the results of the analysis of the Eastern and Southern Hyatt Hotel Regions. Electricity consumption (not demand) only was analyzed. For the combined Eastern and Southern Regions there are 37 hotels with data available for analysis. Four additional hotels had missing data and 3 had data questions. Hotels with UMS installed in 2002 are considered non-UMS for the purposes of this analysis. Fourteen hotels had UMS; 23 did not. The change in electricity consumption per guest night between 2000 and 2002 was analyzed. The data was not weather normalized. Of the 14 UMS hotels, 10 (71%) reduced electricity consumption per guest night between 2000 and 2002. Of the 23 non-UMS hotels, 9 (39%) reduced electricity consumption per guest night. The cumulative savings for the UMS hotels for the year 2002 was \$446,564. The cumulative savings for the non-UMS hotels was (-\$69,028). The average 2002 electricity cost savings for the 14 UMS hotels was \$ 31,897. The average for the 23 non-UMS hotels was (-\$3,001).

A preliminary review of the Western and Central Regions was also conducted. In the Western Region, most of the hotels, UMS or not, reduced their electricity consumption in 2002 compared to 2000. This is probably attributable to the dramatic electricity price increase and the associated price elasticity of demand encountered in the Western Region. In the Central Region many of the hotels, UMS or not, increased electricity consumption in 2002 compared to 2000. The summer of 2002 was much warmer than the summer of 2000 and the data needs to be weather normalized.

This analysis should not be viewed as definitive. The work conducted so far is limited, however, the results to date do suggest that the UMS hotels analyzed are reducing their electricity consumption and that a quick return on investment appears to be likely in many cases.

FUTURE EXPANSION

Hyatt Hotels Corporation plans to complete the installation of their UMS over the next few years. There will also be a major focus on encouraging use of the system by hotel personnel and in developing additional applications. It has become clear that

increasing the automation of the system will be a high priority. Pattern recognition software in the data verification routines will be a future priority as will be expanding the automated links between the hotel UMS and energy management systems.

There will also be a priority placed on using the system to identify energy conservation opportunities. Again, pattern recognition software will help in this regard, but an even more important energy conservation opportunity will be the use of the UMS to support building re-commissioning. The vast majority of Hyatt Hotels have been in operation long enough to be good candidates for re-commissioning. Use of UMS data for re-commissioning may be the single most cost-effective application of the UMS.

SUMMARY & CONCLUSIONS

The Hyatt UMS is still a work-in-progress. The system has been implemented in only about 50 percent of the Corporation's hotels due to individual hotel owner's capital expenditure restrictions. Nevertheless, the results to date are very encouraging and suggest that the implementation will be highly cost-effective. Implementation of the system in the remaining hotels is now mandatory and additional priority is being placed on energy efficiency at the most senior levels of the company.